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# IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Attorney Docket No.: P110US1

First Named Inventor: Peroor K. Sebastian

Douglas A. Cave  
Douglas A. Cave

6/9, 2000  
Date

## UTILITY PATENT APPLICATION TRANSMITTAL (37 CFR. § 1.53(b))

### BOX PATENT APPLICATION

Assistant Commissioner for Patents

Box Patent Application

Washington, DC 20231

**Sir:** This is a request for filing a patent application under 37 CFR. § 1.53(b) in the name of inventors:

Peroor K. Sebastian;  
Arogyaswami J. Paulraj

**For:** A CELLULAR WIRELESS RE-USE STRUCTURE THAT ALLOWS SPATIAL MULTIPLEXING AND DIVERSITY COMMUNICATION

### Application Elements:

- ☒ \*\* 24 Pages of Specification, Claims and Abstract
- ☒ \*\* 9 Sheets of **formal** Drawings
- ☒ \*\* 3 Pages Combined Declaration and Power of Attorney (Duly Executed)

### Accompanying Application Parts:

- ☒ Assignment and Assignment Recordation Cover Sheet (recording fee of \$40.00 enclosed)
- ☐ 37 CFR 3.73(b) Statement by Assignee
- ☒ Return Receipt Postcard
- ☒ Small Entity Statement(s)
- ☐ Other:

Fee Calculation (37 CFR § 1.16)

	(Col. 1) <u>NO. FILED</u>	(Col. 2) <u>NO. EXTRA</u>	<u>SMALL ENTITY</u> <u>RATE</u>	<u>FEE</u>	<u>OR</u>	<u>LARGE ENTITY</u> <u>RATE</u>	<u>FEE</u>
BASIC FEE	\$345 +		\$345	\$	OR	\$690	\$
TOTAL CLAIMS	<u>20</u> -20 = <u>0</u>		x 9 = \$		OR	x 18 = \$	
INDEP CLAIMS	<u>3</u> -03 = <u>0</u>		x 39 = \$		OR	x 78 = \$	
[ ] Multiple Dependent Claim Presented			\$130 = \$		OR	\$260 = \$	
* If the difference in Col. 1 is less than zero, enter "0" in Col. 2.			Total	\$	OR	Total	\$

☒ The Commissioner is authorized to assign the following charges to our Deposit Account No. 501937: 50-1397

➤ \$345.00 for the Utility Application filing fee;

➤ \$40.00 for the recordation of the Assignment presented herewith; and

Any deficiency in fees in connection with this and all subsequent filings with the U.S. Patent and Trademark Office connected with this matter. The Commissioner is also hereby authorized to credit any overpayment of fees to Deposit Account No. 501937. 50-1397

General Authorization for Petition for Extension of Time (37 CFR §1.136)

☒ Applicants hereby make and generally authorize any Petitions for Extensions of Time as may be needed for any subsequent filings.

☒ Please send correspondence to the following address:

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Date: 6/8, 2000

Brian R. Short  
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Reg. No. 41,309

**VERIFIED STATEMENT CLAIMING SMALL ENTITY STATUS  
37 CFR 1.9(f) and 1.27(c)--SMALL BUSINESS CONCERN**

Applicant/Patentee: Peroor K. Sebastian, et al.Application or Patent No. Not Yet Assigned Atty. Docket # P110US1Filing Date: June 8, 2000

I hereby declare that I am

☐ the owner of the small business concern identified below:☒ an official empowered to act on behalf of the small business concern identified below:NAME OF CONCERN: Gigabit Wireless, Inc.ADDRESS: 3099 N. First Street, San Jose, CA 95134

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.3-18, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees under 41(a) and (b) of Title 35, U.S. Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention entitled: A CELLULAR WIRELESS RE-USE STRUCTURE THAT ALLOWS SPATIAL MULTIPLEXING AND DIVERSITY COMMUNICATION, by inventor(s) Peroor K. Sebastian, et al., described in

☒ the specification filed herewith.☐ Application No. \_\_\_\_\_ filed \_\_\_\_\_☐ patent # \_\_\_\_\_ issued \_\_\_\_\_

If the rights held by the above-identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed below\* and no rights to the invention are held by any person, other than the inventor, who could not qualify as a small business concern under 37 CFR 1.9(d) or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e). \*Note: separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

Name: \_\_\_\_\_

Address: \_\_\_\_\_

☐ individual ☐ small business concern ☐ nonprofit organization

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b)).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 1001 of Title 18 of the U.S. Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING: Dr. Arogyaswami J. Paulraj

TITLE IN ORGANIZATION: Founder & CTO

SIGNATURE

DATE 07/11, 2000

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

U.S. Utility Patent Application for:

**A CELLULAR WIRELESS RE-USE STRUCTURE THAT ALLOWS  
SPATIAL MULTIPLEXING AND DIVERSITY COMMUNICATION**

Inventors:

**Peroor K. Sebastian**

**Arogyaswami J. Paulraj**

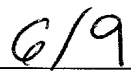
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\_\_\_\_\_  
Douglas A. Cave

\_\_\_\_\_, 2000  
Date

## **A CELLULAR WIRELESS RE-USE STRUCTURE THAT ALLOWS SPATIAL MULTIPLEXING AND DIVERSITY COMMUNICATION**

### **Field of the Invention**

The invention relates generally to wireless communications. More particularly, the invention relates to cellular wireless re-use structures that allow spatial processing using multiple antennae.

### **Background of the Invention**

Wireless communication systems commonly include information carrying modulated carrier signals that are wirelessly transmitted from a transmission source to one or more receivers within an area or region.

Figure 1 shows a prior art wireless cellular array system. The cellular array system of Figure 1 includes clusters of cells with a base station transceiver at the center of each cell. A first cluster (high-lighted) includes a first base station transceiver 110, a second base station transceiver 120 and a third base station transceiver 130. The first base station transceiver 110 is included within a first cell, and includes sectors designated as 1, 2 and 3. The second base station transceiver 120 is included within a second cell, and includes sectors 4, 5 and 6. The third base station transceiver 120 is included within a third cell, and includes sectors 7, 8 and 9.

The sectors 1, 2, 3, 4, 5, 6, 7, 8 and 9 each include unique transmission channels. That is, the transmission characteristics of information signals from the base station transceivers 110, 120, 130 within each sector is unique from the transmission characteristics of the other sectors within the first cluster. For example, the transmission frequency in sector 1 can be at a first frequency, whereas the transmission frequencies of the other sectors include different transmission frequencies. The transmission channels can be uniquely defined by transmission frequency, transmission time, transmission code or any other transmission technique that includes independent transmission channels.

The prior art cellular array systems generally include clusters being repeated. Therefore, the transmission characteristics of each cluster are repeated. The process of repeating transmission frequencies by repeating clusters is generally termed frequency re-use.

A limitation of repeating transmission characteristics is that the cellular array system suffers from co-channel interference. Each cluster within the cellular array system includes the same set of transmission channels having common transmission characteristics as every other cluster within the cellular array system. Therefore, interference occurs between common transmission characteristic cells of different clusters, causing co-channel interference.

To optimize frequency spectrum allocations, frequency re-use cellular array systems repeat transmission frequencies from cluster to cluster. The amount of co-channel

interference between cells of neighboring clusters determines how frequently the transmission frequencies can be re-used, and how close cells having common transmission characteristics can be located.

Receivers within a given sector of the prior art cellular array systems receive information signal from a corresponding base station transceiver. For example, a first receiver 140 within the first sector 1 generally receives only information signals from first base station transceiver 110. A second receiver 150 within the sixth sector 6 generally receives only information signals from the second base station transceiver 120. A third receiver 160 within the eighth sector 8 generally receives only information signals from the third base station transceiver 130.

The ability of wireless systems to transmit information between transmitters and receivers is made difficult by inherent characteristics of the propagation of the transmitted signals through the surrounding environment. The transmitted signals travel along multiple paths before reaching a receiving antenna. The transmitted signals experience different levels of attenuation and propagation delays due to terrain and signal reflections. The attenuation and propagation delays are dependent on the frequency of the transmitted signals. The result is a communication channel that exhibits fading and delay spread.

It is desirable to have an apparatus and method that provides a cellular wireless communication system that can provide enhanced information transmission capacity,

minimize the effects of fading, while allowing for re-use of information carrying signals having common transmission characteristics.

### **Summary of the Invention**

The invention includes an apparatus and a method for a wireless cellular  
5 communication system that provides a cellular wireless communication system that can provide enhanced information transmission capacity, minimize the effects of fading, and allows for re-use of information carrying signals having common transmission characteristics.

A first embodiment of the invention includes a cellular wireless re-use  
10 communication system. The communication system includes a base transceiver station cluster. The base transceiver station cluster includes a first plurality of base station transceivers and a plurality of common channel areas. Each common channel area includes a unique set of common assigned channels. Each common channel area further includes at least one subscriber unit. Each subscriber unit within the common channel area  
15 receives information signals from a second plurality of base station transceivers through a single one of the set of common assigned channels that correspond to the common channel area.

A second embodiment is similar to the first embodiment. The second embodiment includes common assigned channel having a common transmission characteristics. The

common transmission characteristic can include a transmission frequency, a transmission time or a transmission code. For example, the common transmission characteristic can include a frequency-division, a time-division, a spatial-division, a code-division, orthogonal frequency division multiple access (OFDMA), wavelength division multiple access (WDMA), or wavelet division multiple access techniques.

A third embodiment is similar to the first embodiment. The third embodiment includes the second plurality of base station transceivers being physically located within the same common channel area that a corresponding subscriber unit that is receiving information from the second plurality of base station transceivers is located.

A fourth embodiment is similar to the first embodiment. The fourth embodiment includes at least one of the second plurality of base station transceivers being physically located outside of the common channel area that a corresponding subscriber unit that is receiving information from the second plurality of base station transceivers is located.

A fifth embodiment is similar to the first embodiment. The fifth embodiment includes the subscriber unit receiving information signals from a second plurality of base station transceivers through at least one of the set of common assigned channels, allowing for spatial multiplexing.

A sixth embodiment is similar to the first embodiment. The sixth embodiment includes the subscriber unit receiving information signals from a second plurality of base

station transceivers through a one of the set of common assigned channels, allowing for communication diversity. The communication diversity can include transmitter diversity and/or receiver diversity.

A seventh embodiment includes a cellular wireless re-use communication system.

- 5 The communication system includes a plurality of base transceiver station clusters. Each base transceiver station cluster includes at least one base station transceiver and at least one common channel areas. Each common channel area has a unique set of common assigned channels. Each common channel area includes at least one subscriber unit. Each subscriber unit within the common channel area receives information signals from a
- 10 second plurality of base station transceivers through at least one of the set of common assigned channels that correspond to the common channel area.

Other aspects and advantages of the present invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

**Brief Description of the Drawings**

Figure 1 shows a prior art cellular array system.

Figure 2 shows a receiver receiving information signals from a plurality of transmitters.

5        Figures 3a, 3b and 3c show several different cell architectures for cellular wireless systems.

Figure 4 shows a three-cell cluster according to an embodiment of the invention.

Figure 5 shows a cell architecture of Figure 3a repeated to form an array of cells. Each cell includes the same pre-selected transmission channels.

10        Figure 6 shows the three cell structure of Figure 4 repeated to form an array of cells. Each cluster includes the same pre-selected transmission channels.

Figure 7 shows another embodiment of the invention.

Figure 8 shows an overlay of an out-cell spatial multiplexing architecture on a regular 3x3 re-use cell structure.

15        Figure 9 shows an overlay of an in-cell spatial multiplexing architecture on a regular 3x3 re-use cell structure.

**Detailed Description**

As shown in the drawings for purposes of illustration, the invention is embodied in an apparatus and a method for a wireless cellular communication system that provides re-use of information carrying signals, provides for minimization of the effects of fading and delay spread, and allows for enhanced information transmission capacity.

Figure 2 shows a multiple antenna system. Signals transmitted from a first transmitter 210, a second transmitter 220 and a third transmitter 230 are received by a receiver 240. The quality of wireless communications systems can be improved through the use of adaptive spatial processing using multiple antennae. Adaptive antenna processing can be used to improve bit error rate, data rate or spectral efficiency in wireless communication systems. Spatial multiplexing and diversity communication are two prominent spatial processing techniques provided by multiple antenna systems.

Spatial multiplexing is a transmission technology that exploits multiple antennas at both the base transceiver station and at the subscriber units to increase the bit rate in a wireless radio link with no additional power or bandwidth consumption. Under certain conditions, spatial multiplexing offers a linear increase in spectrum efficiency with the number of antennas. For example, if  $N=3$  antennas are used at the transmitter (base transceiver station) and the receiver (subscriber unit), the stream of possibly coded information symbols is split into three independent substreams. These substreams occupy the same channel of a multiple access protocol, the same time slot in a time-division

multiple access protocol, the same frequency slot in frequency-division multiple access protocol, the same code sequence in code-division multiple access protocol or the same spatial target location in space-division multiple access protocol. The substreams are applied separately to the  $N$  transmit antennas and transmitted through a radio channel. Due to the presence of various scattering objects in the environment, each signal experiences multipath propagation.

The composite signals resulting from the transmission are finally captured by an array of receiving antennas with random phase and amplitudes. At the receiver array, a spatial signature of each of the  $N$  signals is estimated. Based on the spatial signatures, a signal processing technique is applied to separate the signals, recovering the original substreams.

Two types of spatial multiplexing implementations are possible. The first includes a single base station transceiver, the second includes multiple base station transceivers. In the single base station transceiver implementation, the transmitter antennas that are used for multiplexing are elements of an antenna array at a base transceiver station. In the multiple base station transceivers implementation, transmitter antenna elements or antenna arrays are located at two or more base station transceivers. The multiple base station transceivers implementation as opposed to the single base station transceiver implementation can provide information signals that are easier to separate. Separation is easier because the multiple base station transceivers antennas transmit information signals

which are received at angles of arrival that are typically greater than the angles of arrival of signals transmitted by single base station transceiver antennas.

Diversity communication is a technique used in multiple antenna-based communication system to reduce the effects of multi-path fading. Transmitter diversity can be obtained by providing a transmitter with two or more (N) antennas. These N antennas imply N channels that suffer from fading in a statistically independent manner. Therefore, when one channel is fading due to the destructive effects of multi-path interference, another of the channels is unlikely to be suffering from fading simultaneously. By virtue of the redundancy provided by these independent channels, a receiver can often reduce the detrimental effects of fading.

Two types of diversity communication implementations are possible. The first includes a single base station transceiver, the second includes multiple base station transceivers. In the single base station transceiver implementation, the transmitter antennas that are used for transmitting information signals are elements of an antenna array at a base transceiver station. In the multiple base station transceivers implementation, transmitter antenna elements or antenna arrays are located at two or more base station transceivers. The multiple base station transceivers implementation as opposed to the single base station transceiver implementation can provide enhanced diversity gain.

Diversity gain is improved because the multiple base station transceivers antennas transmit information signals which are received at angles of arrival that are typically greater than

the angles of arrival of signals transmitted by single base station transceiver antennas, and therefore experience highly independent fading characteristics.

Figures 3a, 3b and 3c show several different cell architectures for cellular wireless systems. Each structure includes several base transceiver stations. For example, Figure 3a includes base transceiver stations 305, 310, 315, 320, 325 and 330. Figure 3a further includes a first subscriber unit 335 and a second subscriber unit 340. The first subscriber unit 335 receives information signals from the base transceiver stations 305, 310, 315, 320, 325 and 330. The second subscriber unit 340 receives information signals from the base transceiver stations 305, 310, 330.

Spatial processing is possible because the subscriber units 335, 340 receive signals from more than one base transceiver station. Therefore, the invention provides a re-use structure that can provide spatial multiplexing or diversity communication.

An embodiment of the invention includes the base transceiver 305, 310, 315, 320, 325 and 330 transmitting information signals at the same carrier frequency. This embodiment further includes the carrier frequency of the cell structure being adjustable to any one of several pre-selected frequencies. Additionally, this embodiment includes repeating the cell structure shown in Figure 3a, in which the pre-selected frequencies are repeated for each of the cells. The pre-selected frequencies are also referred to as common channels. Therefore, repeating the cell structure includes repeating the common channels.

This embodiment can also be extended so that a common channel is defined by the same

time slot in a time-division multiple access protocol system, the same frequency slot in frequency-division multiple access protocol system, the same code sequence in code-division multiple access protocol system or the same spatial target location in space-division multiple access protocol system.

5           Figure 4 shows another embodiment of the invention. This embodiment includes a cluster 410 of wireless re-use cells 415, 420, 425. Subscriber units 430, 432, 434, 436, 438 within each of the cells 415, 420, 425 can receive information carrier signals from several base transceiver stations. For example, a first subscriber unit 430 receives carrier signals from a first base transceiver station 435, a second base transceiver station 440 and a third  
10       base transceiver station 445.

As described above, the carrier signals are transmitted from the base transceiver stations 435, 440, 445 to the first subscriber unit 430 over the same transmission channel. Also as described above, each cell includes multiple pre-selected transmission channels. However, this embodiment includes three cells 415, 420, 425 per cluster 410. Each cell  
15       includes a unique set of multiple pre-selected transmission channels. As will be described later, the cluster 410 is repeated. Therefore, the pre-selected channels of each cluster 410 are repeated, or re-used

Figure 5 shows a cell architecture of Figure 3a repeated to form an array of cells. Each cell includes the same pre-selected transmission channels. It can be appreciated that  
20       single cell structures suffer from high interference between cells. That is, a receiver in one

cell will receive some interference signals from neighboring cells because the neighboring cells share a common transmission channel. As mentioned earlier, the interference between cells having common transmission channels is termed "co-channel interference."

Co-channel interference can be minimized through interference canceling techniques. Generally, interference canceling techniques are well known. However, multiple signals as provided by spatial diversity, and spatially processing the signals received by multiple antenna allows for improved interference canceling techniques.

Figure 6 shows the three cell structure of Figure 4 repeated to form an array of cells. Each cluster includes the same pre-selected transmission channels. As depicted, each cluster (high-lighted) includes three cells. It can be appreciated that the interference between clusters is less for the array of cluster of Figure 6 than for the array of clusters of Figure 5. The clusters of the array of Figure 6 include three cells whereas the clusters of the array of Figure 5 include one cell. The spatial re-use of Figure 6 is less than the spatial re-use of Figure 5, and the resulting signal co-channel interference is less.

Figure 7 shows another embodiment of the invention. This embodiment includes subscriber units 705, 710 receiving information carrier signals from base transceiver units 715, 720, 725 that are physically located both within and outside of the cell/sector each subscriber unit is located. That is, first subscriber unit 705 receives information carrier signals from first base transceiver unit 715 and second base transceiver unit 720. Second

subscriber unit 710 receives information carrier signals from second base transceiver unit 720 and third base transceiver unit 725.

The information carrier signals can include the previously described substreams of information symbols. That is, the first subscriber unit 705 and the second subscriber unit 710 can receive separate information symbol streams from more than one base transceiver units. Therefore, the previously described spatial multiplexing and diversity communication can be realized. However, it should be noted that the substreams are independent in the case of spatial multiplexing, but are copies or versions of the same information stream in the case of diversity communication.

The first base transceiver unit 715 and the third base transceiver unit 725 are located outside of the cell in which the first subscriber unit 705 and the second subscriber unit 710 are located. The first base transceiver unit 715 and the third base transceiver unit 725, however, share the same common channels, along with the second base transceiver unit 720, for subscriber units located in common cells or common channel areas within the cells or clusters. A common channel area is a physical area that a subscriber unit within the area receives information signals from base transceiver units having selected predetermined transmission characteristics. Therefore, as previously described, within the common channel areas, spatial multiplexing and diversity communication can be realized.

Figure 8 shows an overlay of an out-cell spatial multiplexing architecture on a regular 3x3 re-use cell structure. For out-cell spatial multiplexing, at least one of the base

station transceivers generating signals within the common assigned channel corresponding to the common channel area of a corresponding subscriber unit, is located outside of the common channel area. The cell structure of Figure 8 includes clusters of three cells. Each cell is divided into three sectors. Each sector includes a different common channel or information carrier signal frequency. A subscriber unit 810 receives information carrier signals from base transceiver stations 820, 830, 840 located both inside and outside of the cell and/or sector the subscriber unit 810 is located.

For Figure 8, each sector 1, 2, 3, 4, 5, 6, 7, 8, 9 includes a unique set of transmission channels or information signal carrier frequencies. First base transceiver station 820 is located within sector 1. However, second base transceiver station 830 and third base transceiver station 840 can include the same signal channel or transmission frequency to allow the second base transceiver station 830 and third base transceiver station 840 to transmit information signals to the subscriber unit 810 simultaneously with the first base transceiver station 820 transmitting information signals to the subscriber unit 810.

Figure 9 shows an overlay of an in-cell spatial multiplexing architecture on a regular 3x3 re-use cell structure. For in-cell spatial multiplexing, base station transceivers generating signals within the common assigned channel characteristic corresponding to the common channel area of a corresponding subscriber unit, are located inside the common channel area. Within the common channel area (high-lighted) of Figure 9, subscriber units

can receive information signals from three separate base transceiver stations. By adding additional transmission channels to the base station transceivers of a regular 3x3 re-use cell structure, common channel areas can be created.

A regular 3x3 re-use cell structure can include a three cell cluster. As shown in

5 Figure 9, the three cell cluster can include a first cell that includes a first sector 1 having a first transmission channel, a second sector 2 having a second transmission channel and a third sector 3 having a third transmission channel. The three cell cluster can further include a second cell that includes a fourth sector 4 having a fourth transmission channel, a fifth sector 5 having fifth transmission channel and sixth sector 6 having a sixth  
10 transmission channel. The three cell cluster can further include a third cell that includes a seventh sector 7 having a seventh transmission channel, an eighth sector 8 having an eighth transmission channel and a ninth sector 9 having a ninth transmission channel. By adding transmission channels to each sector common channel areas can be created, and subscriber units within a common channel area can receive multiple information signals. For  
15 example, by adding a fifth channel and a ninth channel to the base transceiver station within the first sector 1, adding a first channel and a ninth channel to the base transceiver station within the fifth sector 5, and adding a first channel and a fifth channel to the base transceiver station within the ninth sector 9, a common channel area (high-lighted) is formed by the first sector 1, the fifth sector 5 and the ninth sector 9. Therefore, subscriber  
20 units within the high-lighted common area can receive information signals from three base

station transceivers at either the first transmission channel, the fifth transmission channel or the ninth transmission channel.

Subscriber units within common channel areas can also receive interference signals from neighboring common channel areas that have common transmission channels. For example, as shown in Figure 9, other common channel areas include the first transmission channel, the fifth transmission channel and the ninth transmission channel. Therefore, co-channel interference will generally be present. However, the structure shown in Figure 9 has minimized co-channel interference because the common channel areas are physically spaced apart. Therefore, the interference is weak. Additionally, the structure is uniform. Therefore, the interference is uniform.

The overlay of an in-cell spatial multiplexing architecture on a regular 3x3 re-use cell structure of Figure 9, is adaptable to broadband wireless internet access because internet access is generally very bursty. That is, internet access information transferred between base transceiver stations and subscriber unit tends to occur in bursts. The resulting bursty interference is generally difficult to cancel. However, the uniform low-level interference characteristics of the structure of Figure 9, can be used to limit the effects of bursty interference within broadband wireless internet access systems.

Although specific embodiments of the invention have been described and illustrated, the invention is not to be limited to the specific forms or arrangements of parts so described and illustrated. The invention is limited only by the claims.

Claims

What is claimed:

- 1 1. A cellular wireless re-use communication system comprising:  
2 a base transceiver station cluster, the base transceiver station cluster comprising:  
3 a first plurality of base station transceivers; and  
4 a plurality of common channel areas, each common channel area having a  
5 unique set of common assigned channels;  
6 each common channel area comprising at least one subscriber unit, each  
7 subscriber unit within the common channel area receiving information signals from a  
8 second plurality of base station transceivers through one of the set of common assigned  
9 channels that correspond to the common channel area.
- 1 2. The cellular wireless re-use communication system of claim 1, further comprising a  
2 plurality of base transceiver station clusters.
- 1 3. The cellular wireless re-use communication system of claim 1, wherein each  
2 common assigned channel comprises a common transmission characteristic.
- 1 4. The cellular wireless re-use communication system of claim 2, wherein the  
2 common transmission characteristic is a transmission frequency.

1 5. The cellular wireless re-use communication system of claim 2, wherein the  
2 common transmission characteristic is a transmission time.

1 6. The cellular wireless re-use communication system of claim 2, wherein the  
2 common transmission characteristic is a transmission code.

1 7. The cellular wireless re-use communication system of claim 2, wherein the  
2 common transmission characteristic is at least one of: a frequency-division, a time-  
3 division, a spatial-division, a code-division, orthogonal frequency division multiple access  
4 (OFDMA), wavelength division multiple access (WDMA), wavelet division multiple  
5 access techniques.

1 8. The cellular wireless re-use communication system of claim 1, wherein the second  
2 plurality of base station transceivers generating signals within the common assigned  
3 channel corresponding to the common channel area of a corresponding subscriber unit, are  
4 located within the common channel area.

1 9. The cellular wireless re-use communication system of claim 1, wherein at least one of  
2 the second plurality of base station transceivers generating signals within the common  
3 assigned channel characteristic corresponding to the common channel area of a  
4 corresponding subscriber unit, are located outside of the common channel area.

1 10. The cellular wireless re-use communication system of claim 1, wherein the  
2 subscriber unit receiving information signals from a second plurality of base station  
3 transceivers through a one of the set of common assigned channels, allows for spatial  
4 multiplexing.

1 11. The cellular wireless re-use communication system of claim 1, wherein the  
2 subscriber unit receiving information signals from a second plurality of base station  
3 transceivers through a one of the set of common assigned channels, allows for  
4 communication diversity.

1 12. The cellular wireless re-use communication system of claim 1, wherein the  
2 communication diversity comprises transmitter diversity.

1 13. The cellular wireless re-use communication system of claim 1, wherein the  
2 communication diversity comprises receiver diversity.

1 14. A cellular wireless re-use communication system comprising:  
2 a plurality of base transceiver station clusters, each base transceiver station cluster  
3 comprising:  
4 at least one base station transceiver; and

5 at least one common channel area, each common channel area having a unique set  
6 of common assigned channels;

7 each common channel area comprising at least one subscriber unit, each subscriber  
8 unit within the common channel area receiving information signals from a second plurality  
9 of base station transceivers through a one of the set of common assigned channels that  
10 correspond to the common channel area.

1 15. A method of transmitting multiple information signals to at least one subscriber  
2 unit within a cellular wireless re-use communication system, the system comprising a base  
3 transceiver station cluster, the base transceiver station cluster comprising a first plurality of  
4 base station transceivers, and a plurality of common channel areas, each common channel  
5 area having a unique set of common assigned channels, each common channel area  
6 comprising at least one subscriber unit, the method comprising:

7 a second plurality of base station transceivers transmitting information signals  
8 through one of the set of common assigned channels that correspond to the common  
9 channel area; and

10 each subscriber unit within the common channel area receiving information signals  
11 from the second plurality of base station transceivers through the one of the set of common  
12 assigned channels that correspond to the common channel area.

1 16. The method of transmitting multiple information signals to at least one subscriber  
2 unit within a cellular wireless re-use communication system of claim 15, wherein each  
3 common assigned channel comprises a common transmission characteristic.

1 17. The method of transmitting multiple information signals to at least one subscriber  
2 unit within a cellular wireless re-use communication system of claim 16, wherein the  
3 common transmission characteristic is a transmission frequency.

1 18. The method of transmitting multiple information signals to at least one subscriber  
2 unit within a cellular wireless re-use communication system of claim 16, wherein the  
3 second plurality of base station transceivers transmitting signals within the common  
4 assigned channel corresponding to the common channel area of a corresponding subscriber  
5 unit, are located within the common channel area.

1 19. The method of transmitting multiple information signals to at least one subscriber  
2 unit within a cellular wireless re-use communication system of claim 16, wherein the  
3 second plurality of base station transceivers transmitting signals within the common  
4 assigned channel corresponding to the common channel area of a corresponding subscriber  
5 unit, are located outside of the common channel area.



**Abstract**

The present invention includes a cellular wireless re-use communication system.

The communication system includes a base transceiver station cluster. The base transceiver station cluster includes a first plurality of base station transceivers and a plurality of common channel areas. Each common channel area includes a unique set of common assigned channels. Each common channel area further includes at least one subscriber unit. Each subscriber unit within the common channel area receives information signals from a second plurality of base station transceivers through one of the set of common assigned channels that correspond to the common channel area. The common assigned channel includes common transmission characteristics. The common transmission characteristic can include a transmission frequency, a transmission time or a transmission code. The second plurality of base station transceivers can be physically located within the same common channel area that a corresponding subscriber unit receiving information from the second plurality of base station transceivers is located. Alternatively, at least one of the second plurality of base station transceivers can be physically located outside of the common channel area that a corresponding subscriber unit receiving information from the second plurality of base station transceivers is located.

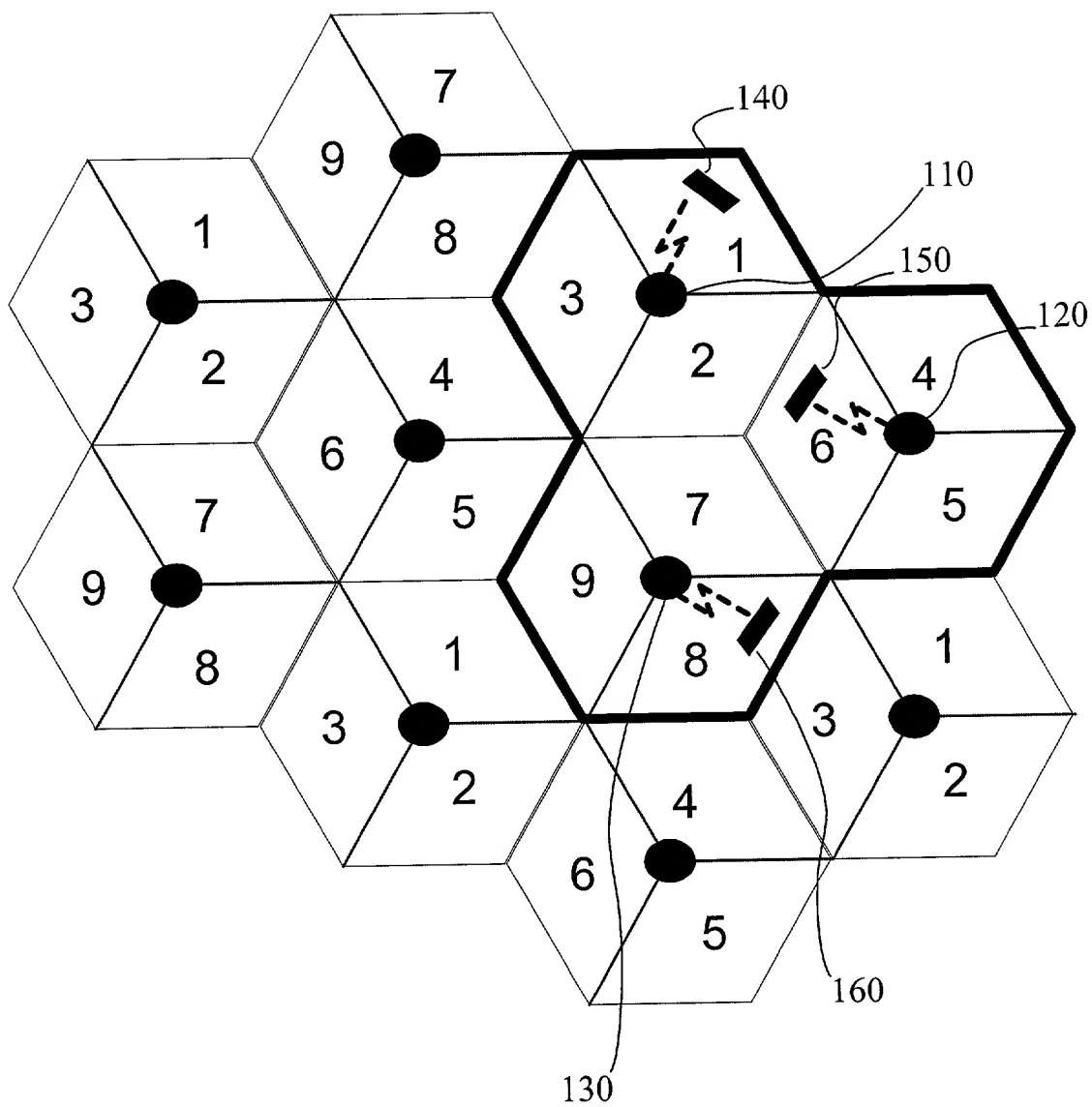


Fig. 1  
(Prior Art)



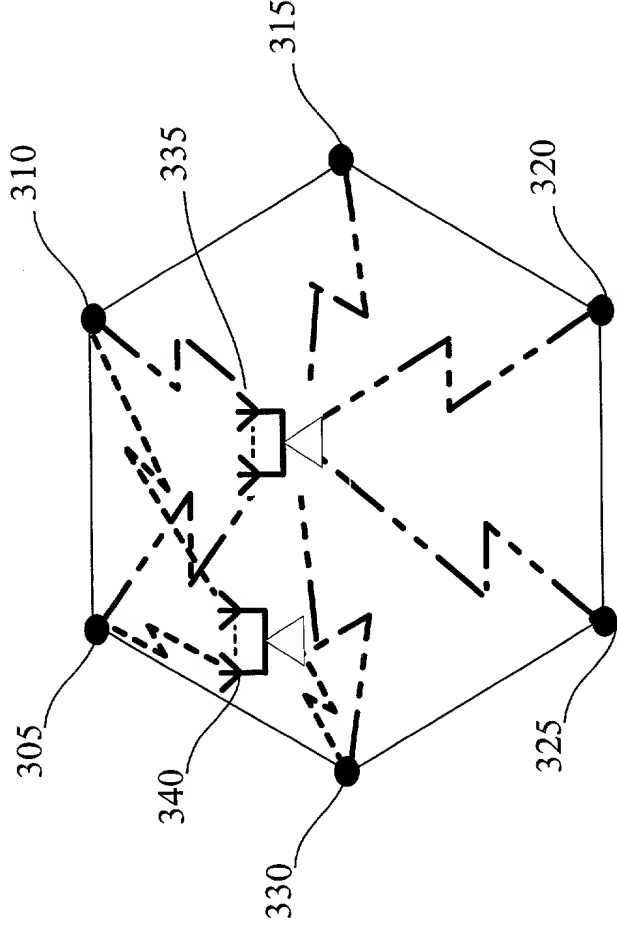


Fig. 3a

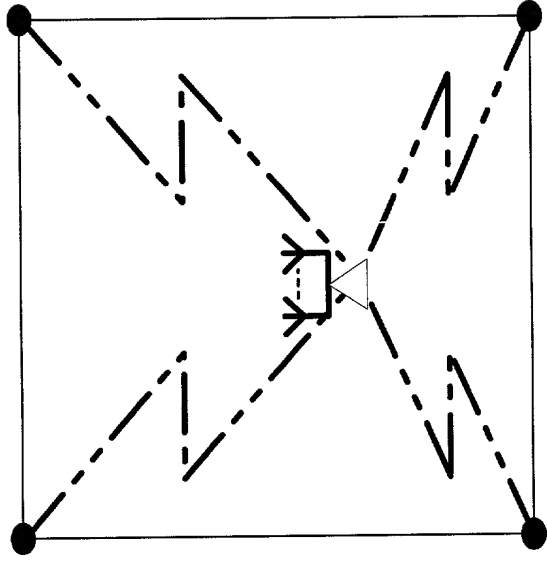


Fig. 3b

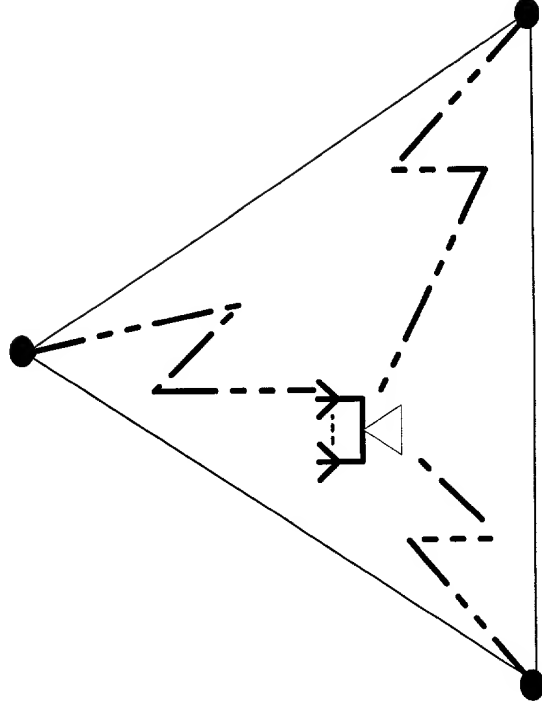


Fig. 3c

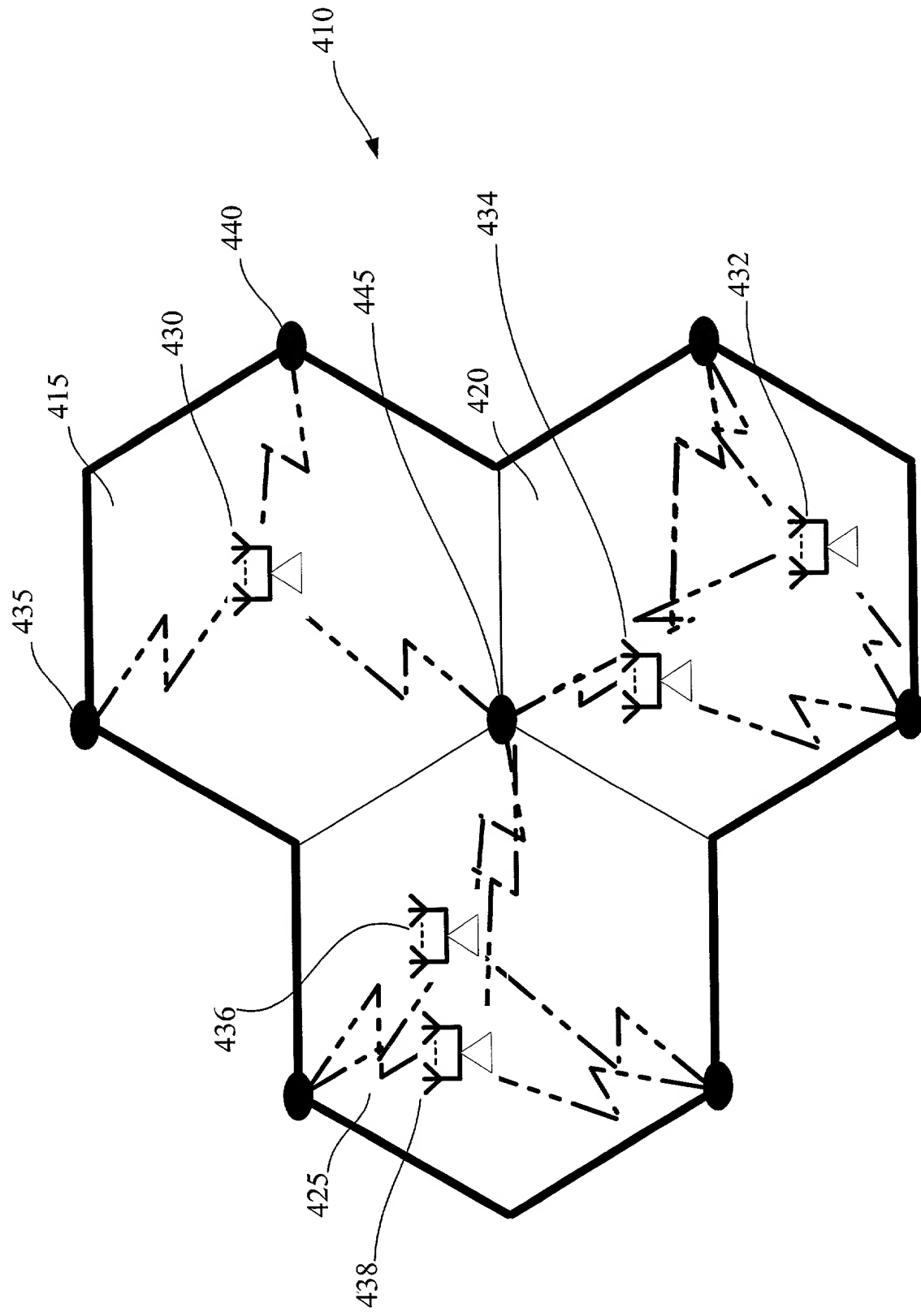


Fig. 4

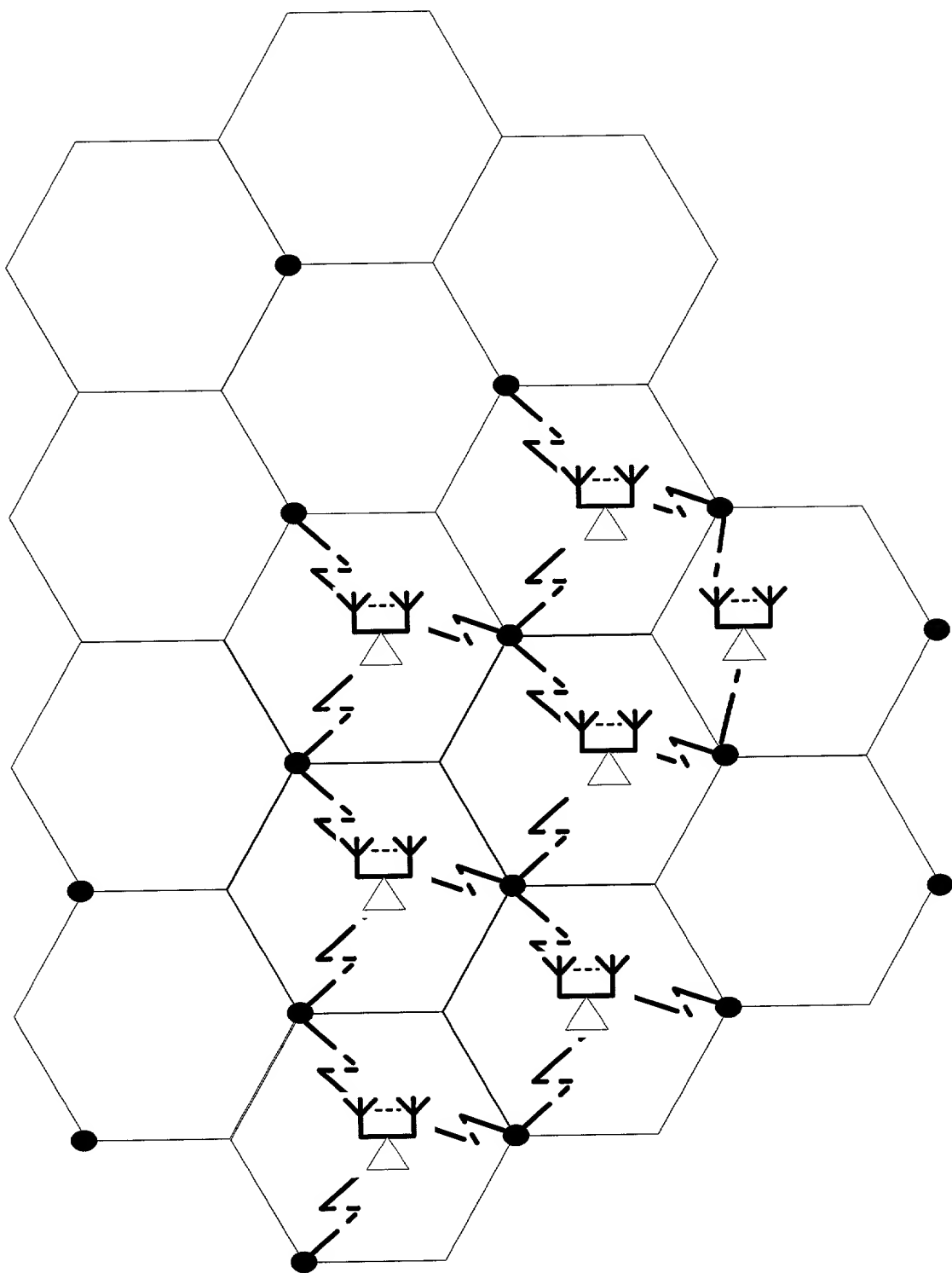


Fig. 5

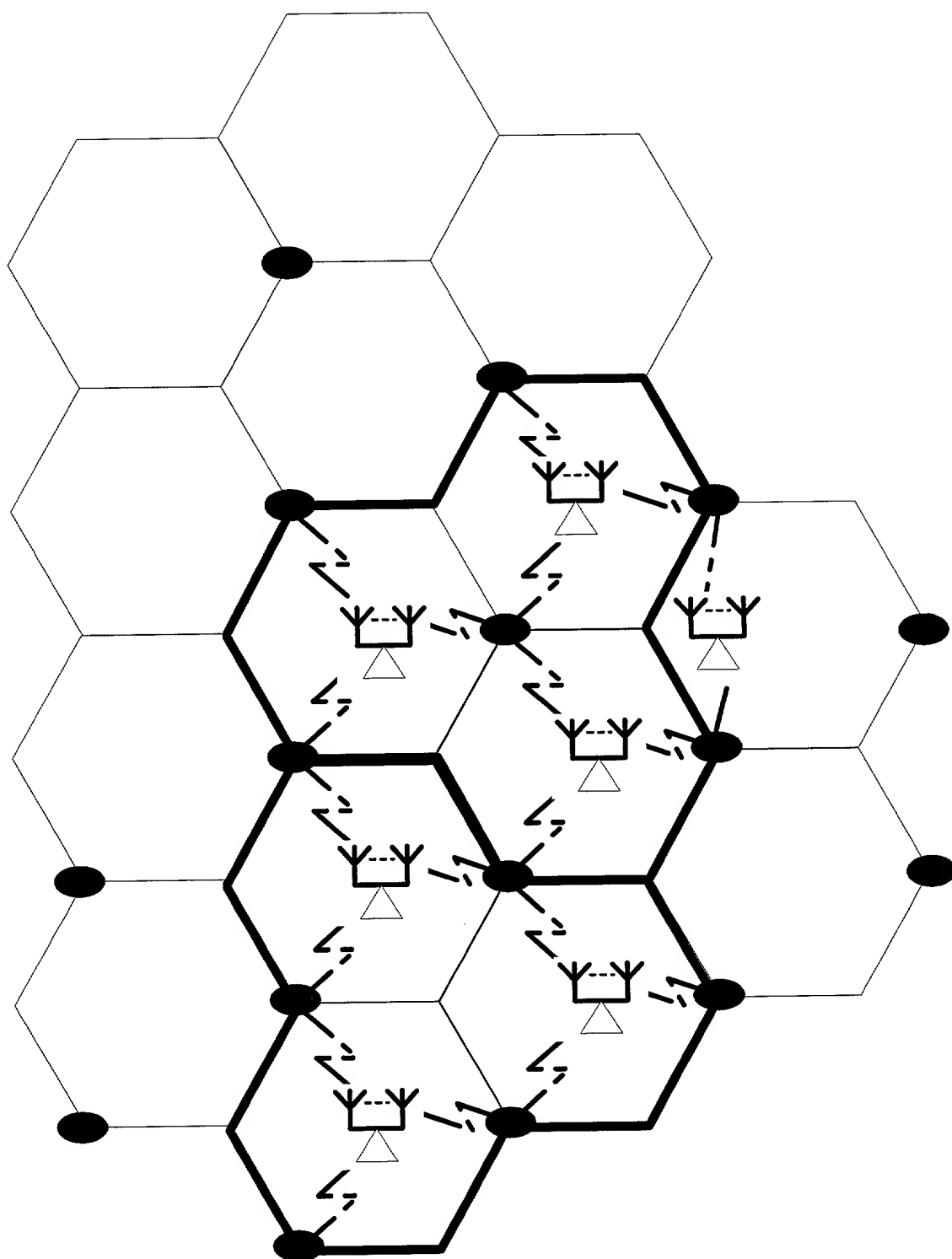


Fig. 6

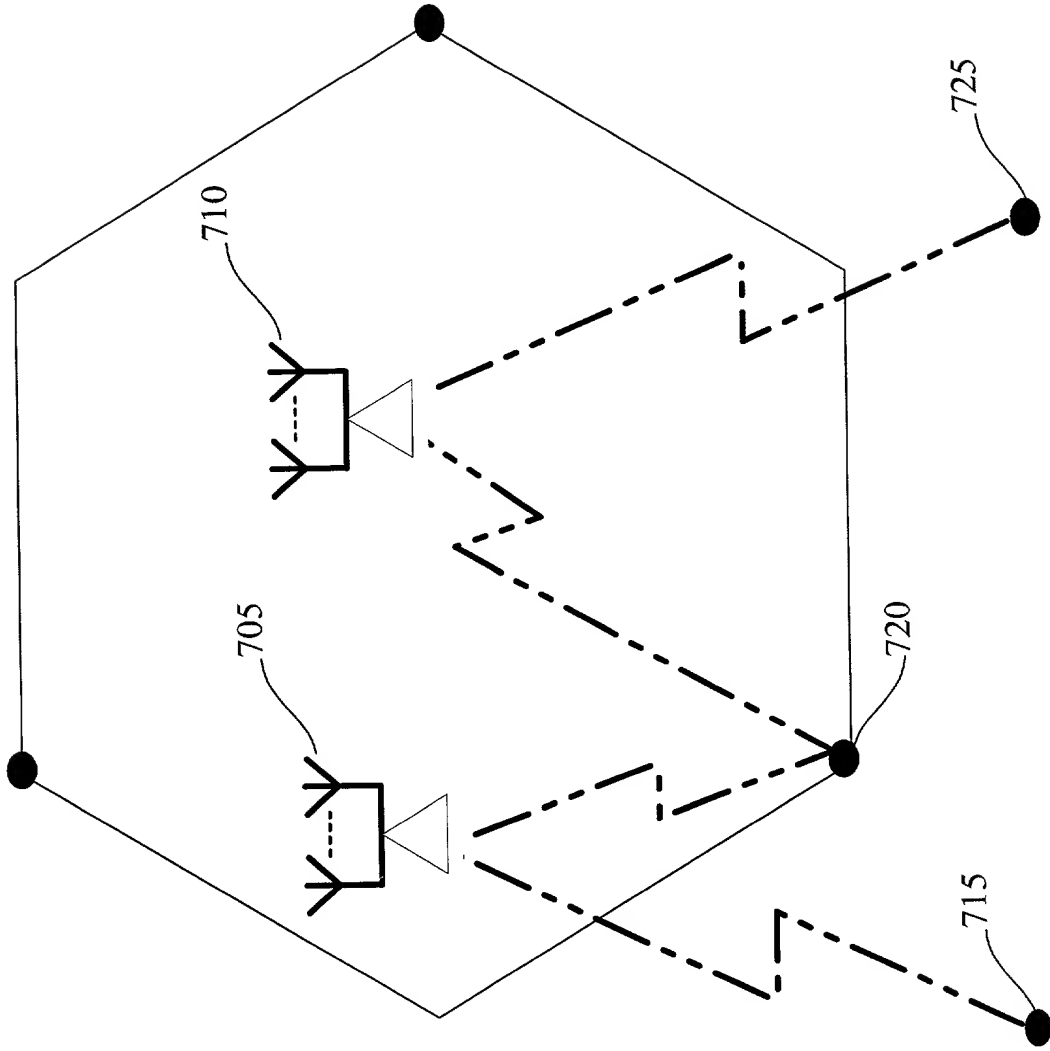


Fig. 7

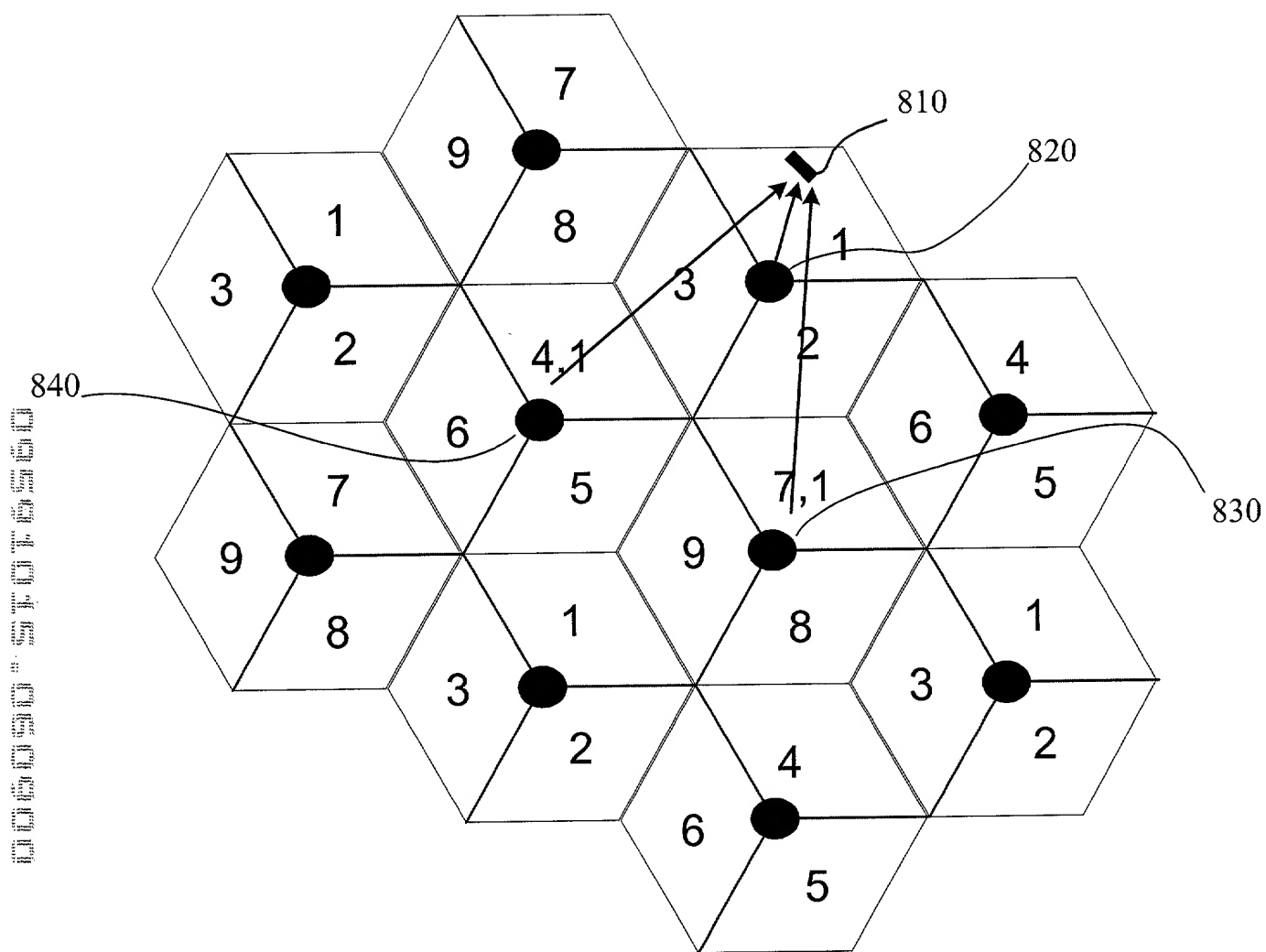


Fig. 8



**DECLARATION AND POWER OF ATTORNEY  
FOR ORIGINAL U.S. PATENT APPLICATION**

Attorney's Docket No. **P110US1**

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: **A CELLULAR WIRELESS RE-USE STRUCTURE THAT ALLOWS SPATIAL MULTIPLEXING AND DIVERSITY COMMUNICATION** the specification of which, is attached hereto.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, CFR § 1.56.

**Prior Foreign Application(s)**

I hereby claim foreign priority benefits under Title 35, United States code, § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed:

Priority Benefits Claimed?

_____	_____	_____		Yes ____	No ____
(Application No.)	(Country)	(Filing Date)			

**Provisional Application(s)**

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below:

_____	_____
(Application No.)	(Filing Date)

**Prior U.S. Application(s)**

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s), or § 365(c) of any PCT International application designating the United States, listed below and, insofar as the

subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

\_\_\_\_\_  
(Application No.)

\_\_\_\_\_  
(Filing Date)

\_\_\_\_\_  
(Status - patented, pending, abandoned)

### Power of Attorney

And I hereby appoint **Brian R. Short, Esq. (Reg. No. 41,309)** as my principal attorney to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith. I also hereby appoint **Steven D. Beyer, Esq. (Reg. No. 31,234), Jeffrey K. Weaver, Esq. (Reg. No. 31,314), and all registered patent agents and patent attorneys of the law firm Beyer & Weaver, LLP, 590 W El Camino Real, Mountain View, CA 94040** to transact any business in the Patent Office connected with the instant U.S. patent application.

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San Jose, CA 95134

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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Figure 1. The effect of the number of iterations on the accuracy of the proposed algorithm. The accuracy is measured by the percentage of correct classification. The results are shown for the 1000 trials. The accuracy is plotted against the number of iterations. The accuracy is generally high, around 90%, and increases slightly with the number of iterations. The error bars represent the standard deviation.